

Processing conjunctive entailment of disjunction

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In a sentence where the disjunction *huo* ‘or’ appears under the negation *mei* ‘no’ (e.g.: *Ta mei chi qingjiao huo qiezi*. ‘He did not eat green peppers or eggplants.’), the sentence is globally ambiguous between the conjunctive interpretation and the disjunctive interpretation. The primary goal of this study is to investigate if there is a default meaning for simple negative statements containing *huo* ‘or’. Data collected from the self-paced region-by-region reading experiment indicated that the participants consistently preferred the conjunctive interpretation. Additionally, in the conjunction-biased condition where the sentences turned out to favor the disjunctive interpretations at the end, there was reading time penalty at the last region of the sentences and participants spent significantly longer time judging the appropriateness of those sentences. Contrary to Jing’s (2008) assertion that both disjunction and conjunction readings are equally prominent in an out-of-the-blue context, the results from the quantitative data revealed that the conjunction reading is the default meaning for simple negative statements containing *huo* ‘or’. The findings of the current experiment provide essential implications to the study of child language acquisition. Specifically, we argue that understanding the adults’ linguistic patterns is a prerequisite to the study of children’s language acquisition patterns.

Keywords: conjunctive entailment of disjunction, *huo*, or, quantitative data, ambiguity

1. The backdrop

1.1 The downward entailing ‘or’

One of the interesting aspects of doing linguistic research is that run-of-the-mill sentences such as those in (1) tell us more than what we may first expect.

- (1) a. Ta mei shuo guo Zhangsan hui shuo Zhongwen huo Yingwen].
 He not say ASP_{IP}[Zhangsan can speak Chinese or English¹
 'He did not say Zhangshan speaks Chinese and English.'
 b. He did not say_{IP}[John speaks Chinese or English].

(1) demonstrates one of the traditional de Morgan's Laws, the conjunctive entailment of disjunction, i.e. $\neg(A \vee B) \Rightarrow \neg A \wedge \neg B$ (Partee et al. 1990). The inclusive use of *huo* 'or' in (1a) or *or* in (1b) is licensed by a negation appearing in a higher clause than the clause that contains disjunction (Crain & Thornton 2006). Instead of delivering the disjunctive meaning, the conjunctive interpretations are derived, showing that Zhangshan did not say that Lishi speaks Chinese *and* English. This is a phenomenon that exists in many natural languages (e.g. German, Japanese, Hungarian, and Russian) (see Crain 2008; Goro & Akiba 2004; Szabolcsi 2002).

This seemingly perfect cross-linguistic pattern, however, disappears when the negation is a clause-mate of *huo* 'or'.

- (2) Ta mei chi qingjiao huo qiezi.
 He not eat green peppers or eggplants
 Reading a: 'He did not eat green peppers or he did not eat eggplants.'
 Reading b: 'He did not eat green peppers and he did not eat eggplants.'

(2) is ambiguous between the conjunctive reading and the disjunctive reading. That is, the truth conditions of the sentence are confirmed as long as the person eats either of the vegetables or neither of them. Jing (2008) ascribes the ambiguity in (2) to different scope interpretations of negation and *huo* 'or'. When the negation scopes over *huo* 'or', as shown in (3), showing neither of the propositions hold, the conjunctive reading is derived. When the disjunction scopes over the negation, showing that one of the negative propositions holds, the disjunctive reading is derived, as shown in (4).

- (3) Narrow scope disjunction interpretation (NSD)
 [adapted from Jing (2008) (4)]
 a. $\neg(Pa \vee Pb)$
 b. It is not the case that he ate either green peppers or eggplants.
- (4) Wide scope disjunction interpretation (WSD) [adapted from Jing (2008) (5)]
 a. $\neg Pa \vee \neg Pb$
 b. John did not eat green peppers or John did not eat eggplants.

In this respect, Chinese differs from many other natural languages. For instance, in English, statements of the form *not* [*A or B*] in simple negative sentences always

1. Abbreviations used in this study include ASP: aspect marker, MP: modal particle; and SFP: sentence final particle.

convey the *neither...nor* reading (Crain 2008. But see Jing (2008) for an alternative view.). On the other hand, native speakers of Japanese, Hungarian and Russian do not generate the *neither...nor* reading in simple negative statements in the form of *not [A or B]* (Crain 2008).²

1.2 Previous investigation on 'or'

Because the conjunctive entailment of disjunction is so special, it attracted much attention from researchers. However, previous investigations into the conjunctive entailment of disjunction predominantly focused on how children comprehended the ambiguous *or* and when they started to show adult-like competence (Chierchia et al. 2001; Chierchia et al. 2004; Crain et al. 2002; Crain et al. 2006; Gualmini & Crain 2002; Gualmini & Crain 2004; Gualmini et al. 2001; Guasti et al. 2005) and the adult participants were only included to serve as controls. That was also the case for studies focusing on the conjunctive entailment of disjunction under the scope of negation in Chinese (Jing 2008; Jing et al. 2005; Su et al. 2012).

The study reported by Jing et al. (2005) examined how 21 monolingual Chinese-speaking children (mean 4;10, from 4;4 to 5;3) and 10 adult controls interpreted simple negative sentences with *huozhe* 'or' by using Truth Value Judgment Task (Crain & McKee 1985; Crain & Thornton 1998).³ A typical story in the experiment had the following plot: Three characters, Mickey Mouse, Donald Duck, and the Smurf, joined a lifting contest. Any of them that lifted both a TV and a desk (subsequently) successfully could receive a gold medal as a reward. If any of them lifted either of the two objects, the character would receive a silver medal. If someone failed to lift either object, the character got nothing. After the contest, Mickey Mouse received a gold medal, Donald Duck received a silver medal and the Smurf received nothing. At the point, the fourth character, Kermit, appeared and intended to guess who lifted up what by the medal they had. The following three sentences were uttered (from Jing et al. 2005 (11)–(13)):

- (5) Milaoshu juqi le zhuzi he dianshiji
 Micky-Mouse hold ASP table and TV
 'Mickey Mouse lifted up the table and the TV.'

2. Providing an explanation for accounting for this cross-linguistic discrepancy is beyond the scope of the current study. Readers who are interested in this issue may refer to Goro & Akiba (2004), who attempt to provide an answer for the puzzle.

3. One may notice that previous studies use *huozhe* instead of the abbreviated form *huo* used in this study, although they have the same semantic and syntactic functions. The reason that *huo* is preferred in this study is because it is more natural. Section 2 provides more detailed information.

- (6) Tanglaoya meiyou juqi zhuzi huozhe dianshiji
 Donald-Duck not hold table or TV
 'Donald Duck did not lift up the table or did not lift up the TV.'
- (7) Lanjingling meiyou juqi zhuzi he dianshiji
 Smurf not hold table and TV
 'The Smurf did not lift up the table and did not lift up the TV.'

For control sentences such as (5) and (7), all the child and adult participants accepted them as accurate descriptions. The two groups, however, had different truth values for (6). Whereas adult controls always accepted (6) as an accurate description, 20 out of 21 children rejected it. That is, the adult participants in the study always interpreted *huozhe* as a disjunction and did not follow de Morgan's Laws. However, the results might not be used to argue that the disjunctive use was more prominent than the conjunctive use because the context led participants to pay more attention to the disjunctive interpretation. Recall that in the story, participants were informed that as long as any of the characters lifted either of the two objects, the character received a silver medal. Therefore, when adults participants knew that Donald Duck received a silver medal, they were aware that the character lifted only one of the objects. As a result, when evaluating sentences like (6), they naturally first examined whether the sentence could mean 'either' or not. In short, the design of the story led participants to first consider whether the sentence with the 'either' interpretation was an adequate description of the given context, giving rise to adult participants' prevalent preference of the 'either' interpretation.⁴

A subsequent study carried out by Jing (2008) showed that when felicitous contexts were provided, both disjunctive and conjunctive interpretations could be achieved. Although Jing's experiment results suggested that, for an adult native speaker of Mandarin Chinese, these two meanings were indeed available, she claimed, without support from quantitative data, that both wide scope disjunction and narrow scope disjunction readings were equivocal in Mandarin Chinese (Jing 2008: 8).⁵

In short, previous studies such as those carried out by Jing et al. (2005) and Jing (2008) had investigated the meaning of *huozhe* when it was a clause-mate of negation. However, the design of Jing et al.'s (2005) study did not allow us to

4. This paper does not intend to provide a detailed account for why adults and children produced different patterns of judgments. One possibility is that children have limited processing capacity (see Liu & Lee (2014); Syrett & Lidz (2009); and Trueswell et al. (1999) for a detailed discussion).

5. The term *equivocal* is directly adopted from Jing (2008: 8), meaning that two readings are equally prominent. In order to avoid the possible ambiguity, the term *equally prominent* is used for the rest of the paper.

discover the default meaning of the form *not* [*A or B*] and Jing's (2008) study directly asserted that both disjunction and conjunction meanings were equally prominent without support from quantitative data.

1.3 The role of quantitative methods in linguistics

Before introducing the current study, we would like to briefly discuss the role of quantitative data in linguistic research. It has long been a debate pertaining to the need for quantitative methods in linguistic research (Culicover & Jackendoff 2010; Gibson & Fedorenko 2010; Gibson et al. 2013; Myers 2009a; Phillips 2009; Sprouse & Almeida 2013). Recent empirical studies focusing on grammaticality/acceptability judgments of certain syntactic constraints showed that quantitative methods were essential in linguistic research. Specifically, empirical investigations targeting determiner phrases and number phrases in Chinese (Myers 2009b), adjunct and conjunct island constraints in Chinese (Myers 2012), imperative-and-declarative construction in English (Scontras & Gibson 2011) and multiple-wh-extractions in English (Gibson & Fedorenko 2013) all indicated that the results of traditional intuitive grammaticality/acceptability judgments from researchers or/and their colleagues did not always perfectly reflect the patterns collected from quantitative methods. In fact, it is not always easy for native speakers of a specific language to intuitively select the more prominent meaning of a globally ambiguous sentence. For instance, Liu & Lee (2014) investigated globally ambiguous sentences with the modal verb *yinggai* 'should' in Mandarin Chinese, which can be construed as the root modality (8a) showing obligation and the epistemic modality (8b) showing possibility.

(8) [From Liu & Lee (2014) (10)]

Xiaohua *yinggai* *shangchuang* *shuijiao* *le*.

Xiaohua should go-to-bed sleep SFP

Reading a: Xiaohua is obligated to go to bed now.

Reading b: It is the case that Xiaohua has gone to bed.

Their experimental results from Truth Value Judgment Task showed that adult native speakers of Mandarin Chinese predominantly set the epistemic reading (72.97%) as the default interpretation. In fact, the default meaning of the global ambiguous sentences containing *yinggai* 'should' in an out-of-the-blue context can only be known by the support from the quantitative data.

As these two data collecting methods do not conflict and can all be adopted to compensate each other in order to faithfully depict the linguistic data, the quantitative data and data from the intuitive judgments are all collected in the current study.

1.4 The present study

The main purpose of the research is to investigate if there is a default interpretation for simple negative statements containing *huo* ‘or’ by collecting quantitative data from an on-line real-time self-paced reading experiment. More specifically, contrary to Jing’s (2008) intuitive judgment, it is argued that there is a default meaning for simple negative statements containing *huo* ‘or’. In what follows, the design and the hypothesis of the experiment are introduced in §2. Section 3 displays the results. A discussion based on the results and the methodological implications are presented in §4. Section 5 concludes the paper.

2. Methods

2.1 Participants

Thirty-two undergraduate students from a university in Taiwan were recruited in this experiment for class credit. They are all native speakers of Mandarin Chinese. Two participants were later excluded from this study because they had an accuracy rate lower than 80% in the acceptability-judging section. The 80% accuracy rate threshold is acceptable in comparison to many self-paced region-by-region reading experiments in the literature. For instance, Aoshima et al. (2004: 31) set up the accuracy rate threshold at 70% for target sentences and 80% for total sentences. Accuracy rate thresholds set at 67% (Hsiao & Gibson 2003: 10), 70% (Gibson & Wu 2013: 141) and 75% (Hsu 2006: 101) can also be found in the literature. Therefore, the current study setting the accuracy rate threshold at 80% should be acceptable.

2.2 Design and materials

A self-paced region-by-region reading experiment (Just et al. 1982), using Linger 1.7 by Doug Rohde (Rohde 2001–2003) as the software to run the task, was employed. Fourteen sets of critical items were constructed and presented in Chinese characters, each with the two conditions in (9a) and (9b) (with subscripts showing the contents for each region in (9)). The full set of critical items are listed in Appendix 1. The sentences were presented in a Latin-Square design. That is, in each set of sentences, each participant read stimuli from one of the two conditions (e.g. either (9a) or (9b)), and the conjunction-biased and disjunction-biased stimuli were counterbalanced. Therefore, for the fourteen sets of critical items, each participant read seven disjunction-biased stimuli and seven conjunction-biased stimuli. These 14 critical stimuli were intermixed with 28 filler sentences. A full set

of fillers are listed in Appendix 2. All the sentences were presented visually without audio because the possible influence from stress must be removed. For instance, when *huo* 'or' is uttered with extra stress, the conjunctive interpretation becomes implausible. In order to exclude the potential confounding factor, the reading experiment was adopted.

(9) a. Conjunction-Based Interpretation

A: Ta₁ mei-chi₂ qingjiao₃ huo₄ qiezi₅.

He not-eat green pepper or eggplant

Reading a: 'He did not eat green peppers or he did not eat eggplants.'

Reading b: 'He did not eat green peppers and he did not eat eggplants.'

B: Dui-a₆ qingjiao₇ han₈ qiezi₉ ta₁₀ dou₁₁ bu-xihuan₁₂

Yes-MP green pepper and eggplant he all not-like

'Yes! He likes neither green peppers nor eggplants.'

b. Disjunction-Biased Interpretation

A: Ta₁ mei-chi₂ qingjiao₃ huo₄ qiezi₅.

He not-eat green pepper or eggplant

Reading a: 'He did not eat green peppers or he did not eat eggplants.'

Reading b: 'He did not eat green peppers and he did not eat eggplants.'

B: Dui-a₆ qingjiao₇ han₈ qiezi₉ ta₁₀ zhi₁₁ chi-yi-zhong₁₂

Yes-MP green pepper and eggplant he only eat-one-kind

'Yes! He only eats one of them.'

The ambiguous sentence from interlocutor A in (9a) and (9b) was the same. The objects in interlocutor B's statements were topicalized in order to avoid any scope ambiguities. The truth conditions of the sentence are confirmed as long as the person eats *either* of the vegetables or *neither* of them. Therefore, when interlocutor B in (9a) replied by saying that the person they were discussing likes neither of the vegetables, the sentence could make sense as long as the conjunctive interpretation was available to the readers; otherwise they would feel interlocutor B's response was not suitable. When interlocutor B in (9b) replied by saying that the person they were discussing likes either of the vegetables, the sentence could also make sense as long as the disjunctive interpretation was available to the readers; otherwise they would feel interlocutor B's response was not suitable. After reading each short conversation, readers were invited to judge the appropriateness of interlocutor B's response. The participants' judgments of the appropriateness of interlocutor B's responses provided us a window to understand their default setting of simple negative statements containing *huo* 'or'. For instance, if they consistently judged that interlocutor B's response in (9a) was appropriate and judged that interlocutor B's response in (9b) was inappropriate, it was manifested that those par-

ticipants' default interpretation of the ambiguous sentence was the conjunction reading instead of the disjunction one.

The number of the syllables/characters in these conditions (i.e. the conjunction-based interpretation and the disjunction-biased interpretation) was the same. The regions in the sentences were words, with the exception of verbs that were presented in verbal chunks (e.g. Negation-V and V-Number-Classifier). These chunks served as fixed expressions, which repeatedly occurred in the critical and filler sentences. Additionally, the number of the propositions was also the same. As the ambiguous sentence from interlocutor A was the same in two conditions, in the following example, the focus is on the statements from interlocutor B in (9a) and (9b). In (9a), the sentence from interlocutor B consisted of two propositions, *Ta bu-xihuan qingjiao* 'He doesn't like green peppers' and *Ta bu-xihuan qiezi* 'He doesn't like eggplants'. In (9b), the sentence from interlocutor B also consisted of two proposition, *Ta zhi chi qingjiao* 'He only eats green peppers' and *Ta zhi chi qiezi* 'He only eats eggplants'.

The hypothesis of this study is as follows: If the two ambiguous readings of the statement made by interlocutor A are equally prominent, as asserted by Jing (2008), no reading time penalty is expected for the sentences made by interlocutor B in (9a) and (9b). On the other hand, if only one of the sentences is read faster and is easier to comprehend than the other one, it reveals that these two interpretations are not equally prominent and one of them is the default interpretation. Additionally, if there were any effects for the on-line reading time, the effects were predicted to appear at region 11 and the acceptability-judging section. The reason was that the materials in the two conditions (the conjunction-biased interpretations and the disjunction-biased interpretations) were exactly the same for the first ten regions. It was until region 11 that the conjunction-biased interpretations and the disjunction-biased interpretations were revealed by the critical words *dou* 'all' and *zhi* 'only', respectively.

One essential thing to note here is that, unlike previous studies, this study used *huo*, an abbreviated form of *huozhe*, although they have the same syntactic and semantic functions. The reason is that, in comparison to *huozhe*, *huo* is more natural in daily use. A corpus search using Chinese Sketch Engine (<http://word-sketch.ling.sinica.edu.tw>) (Huang et al. 2005; Kilgariff et al. 2004) reveals that, when *huo* and *huozhe* serve as conjunctions, there are 16,599 and 1,820 instances for *huo* and *huozhe* respectively, indicating that in daily use, *huo* is more frequently used and more natural than *huozhe*.

2.3 Procedure

At the beginning of each trial, dashes, showing the length and positions of the words in the sentences, came out. When the participants pressed the spacebar, the dashes for the first region became characters. When the participants pressed the spacebar again, the first regions became dashes again and the second fragment of the material appeared. The process continued until they finished reading one set of materials.

To ensure that the participants comprehend the sentences, they were invited to judge if the responses provided by interlocutor B were acceptable. Due to the fact that none of the 14 critical items had a standard response, half of the 28 fillers were set to be semantically unacceptable, making the *Yes* and *No* responses balanced.

Each participant had 13 practice sentences to familiarize themselves with this reading mode before the experiment formally started. The experiment took around 15 minutes, depending on individual differences.

2.4 Data treatment

Because either *Yes* or *No* responses to sentences like (9) were possible and acceptable, the accuracy rate was only calculated based on the percentage of their correct answers to the filler sentences. The amount of time participants spent on each region and answering questions was recorded. One thing to note here is that the reading time for the twelfth region and the acceptability-judging time were added together. The reason is that the experimenters observed that the participants generally stopped longer at the twelfth regions (e.g. the *bu-xihuan* in (9a) and the *chi-yi-zhong* in (9b)) and immediately provided their acceptability judgment when they proceeded to the acceptability-judging section, which appeared right after they finished reading the last region. Due to the fact that some participants stopped and spent extra time making their final acceptability judgments at the twelfth regions (i.e. at *bu-xihuan* ‘not like’ and *chi-yi-zhong* ‘eat one kind’ instead of at the acceptability-judging section), the time for the twelfth region and the acceptability-judging time were added together to form the new acceptability-judging time.

The percentage of the conjunctive/disjunctive interpretations was calculated based on the participants’ appropriateness judgment to interlocutor B’s responses. In the conjunction-biased-interpretation condition (e.g. (9a)), the responses were coded as in favor of the conjunctive interpretation when the participants judged interlocutor B’s responses as acceptable and were coded as in favor of the disjunctive interpretation when the participants judged interlocutor B’s responses as unacceptable. On the other hand, in the disjunction-biased-interpretation condition

(e.g. (9b)), the responses were coded as in favor of the conjunctive interpretation when the participants judged interlocutor B's responses as unacceptable and were coded as in favor of the disjunctive interpretation when the participants judged in interlocutor B's responses as acceptable.

3. Results

3.1 Accuracy rate

The overall accuracy rate for the thirty participants was 94.29%.

3.2 Reading time

Figure 1 shows the reading time of each region in interlocutor A's statement and B's response. Table 1 displays the acceptability-judging time participants spent on two kinds of sentences. As this study employed a repeated-measure design, twelve paired-samples t-tests were performed to examine if there were any reading time differences among the regions.⁶ Two comparisons showed statistically significant differences.⁷ The results from region 11 revealed that the participants spent significantly more time reading sentences biased toward the disjunctive interpretation ($M = 461.48$; $SD = 179.95$) than sentences biased toward the conjunctive interpretation ($M = 410.20$; $SD = 113.33$), $t(29) = -2.24$, $p = .033$. The results from the acceptability-judging time revealed that the participants also spent significantly more time judging sentences biased toward the disjunctive interpretation ($M = 3311.49$; $SD = 1813.69$) than sentences biased toward the conjunctive interpretation ($M = 2491.06$; $SD = 1285.66$), $t(29) = -2.83$, $p = .008$. The results indicated that it took participants longer time to comprehend and judge the ac-

6. An anonymous reviewer pointed out that those eleven regions were not independent and therefore using t-tests might not be appropriate. However, in the literature of the self-paced-reading experiment, an ANOVA (Aoshima et al. 2004; Gibson & Wu 2013; Hsiao & Gibson 2003; Hsu 2006) or a t-test (Lin 2006) analysis was used to compare the differences between/among reading times at different regions, depending on the number of the groups/conditions in the study. Therefore, we chose to follow the literature and ran t-tests. At the same time, we acknowledged the Type I risk in the current analysis.

7. At region 3, although the difference between the conjunction-based interpretation ($M: 457.35$; $SD = 173.99$) and the disjunction-based interpretation ($M: 427.38$; $SD = 124.38$) might be regarded as significant, the result showed that the difference was not significant, $t(29) = 1.070$, $p = .293$. The non-significant-difference result might result from the larger standard deviations.

ceptability of sentences biased toward the disjunctive interpretation, indicating that the conjunctive interpretation was easier to comprehend.

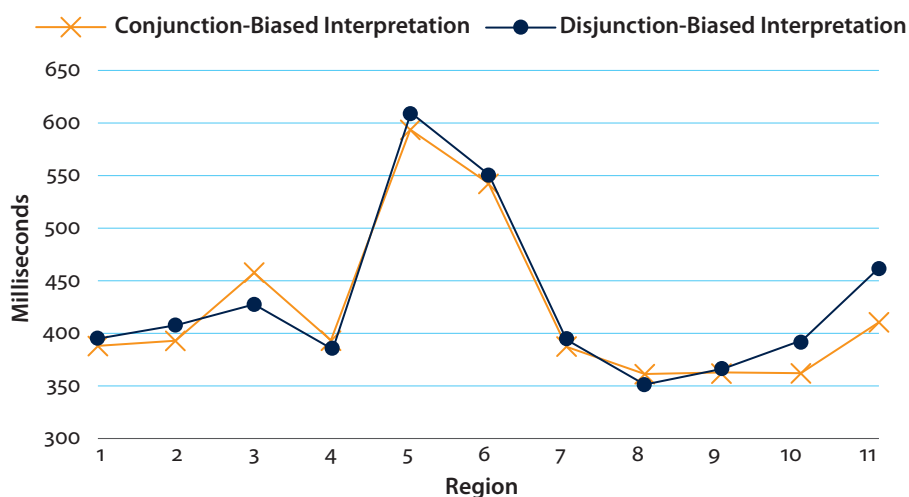


Figure 1. Reading time for each region

- (A: Ta₁ Negation-V₂ NP1₃ huo₄ NP2₅
 B: Dui-a₆ NP1₇ han₈ NP2₉ ta₁₀ dou₁₁/zhi₁₁)

Table 1. Acceptability-judging time (Unit: milliseconds)

Sentence Type	Reading Time
Conjunction-Biased Sentences (e.g. 9a)	2491.06
Disjunction-Biased Sentences (e.g. 9b)	3311.49

3.3 Conjunction or disjunction?

Table 2 indicates the percentage of the conjunctive/disjunctive interpretation in conjunction/disjunction-biased sentences. A logistic regression was performed to ascertain the effects of context (i.e. the conjunction-biased-interpretation context and the disjunction-biased-interpretation context) on the likelihood that the participants interpreted the sentences as the conjunctive interpretations or the disjunctive interpretations. The probability value for the logistic regression model was right at the point-o-five level, $\chi^2(1) = 3.843, p = .05$. The model only explained 1.4% (Nagelkerke R^2) of the variance in the participants' conjunctive-or-disjunctive-interpretation judgment. Furthermore, as it is shown in Table 3, the context was not a significant predictor for the conjunction-or-disjunction interpretation,

$p = .052$. In short, in both contexts, participants systematically preferred the conjunctive interpretations.

Table 2. Summary of the conjunctive/disjunctive interpretation (Unit:%)

	<i>Conjunctive Interpretation</i>	<i>Disjunctive Interpretation</i>
Conjunction-Biased Sentences (e.g. 9a)	80.48	19.52
Disjunction-Biased Sentences (e.g. 9b)	76.19	23.81

Table 3. Logistic regression predicting the conjunction-or-disjunction interpretation

<i>Variable</i>	β	<i>SE</i>	<i>Odds ratio</i>	<i>p</i>
Context	-.453	.233	.636	.052
Constant	-.963	.154	.382	.000

4. Discussion

The primary goal of the research is to investigate if there is a default meaning for the meaning of simple negative statements containing *huo* ‘or’. The results from the self-paced region-by-region reading experiment indicated that the participants consistently preferred the conjunctive interpretation in both conjunction-biased and disjunction-biased sentences. Additionally, there was reading time penalty at the last region of disjunction-biased sentences. Participants also spent significantly longer time judging the appropriateness of disjunction-biased sentences. The results together revealed that the conjunctive reading and the disjunctive reading were not equally prominent and the conjunctive reading was the default meaning for the simple negative statements containing *huo* ‘or’.

The prediction from Jing’s (2008) assertion was that if the two ambiguous readings (i.e. WSD and NSD) were equally prominent, no reading time penalty was expected for either conjunction-biased and disjunction-biased sentences. On the other hand, if only one of the sentences was read faster and was easier to comprehend than the other one, it revealed that these two interpretations were not equally prominent and one of them was the default interpretation. The experiment results, showing that the conjunctive reading was easier to comprehend, therefore, cast doubt on the assertion made by Jing (2008). That is, there is indeed a more prominent reading for Chinese simple negative statements containing *huo* ‘or’. Additionally, in the same study, Jing (2008: 7) also asserted that when *or* appears in negative simple statements in English, both the conjunctive and disjunctive readings were available, but without any given context, native speakers of English

were more likely to understand it as a conjunction. Again, her claim was without any support from quantitative data. As her assertion in Chinese failed to faithfully describe the real phenomenon, it is therefore strongly suggested that quantitative data should be collected to add weight to her proposal.

The current results provide important implications to studies in first language acquisition. In recent years, several studies focusing on children's interpretations of the conjunctive entailment of disjunction in a variety of contexts have been reported (e.g. Su 2013; Su & Crain 2013; Su et al. 2012). However, without understanding the default interpretation of the conjunctive entailment of disjunction, children's acquisition patterns cannot be fully understood. For instance, Su & Crain (2013: 610) cited Jing et al.'s (2005) study, along with other studies, to argue against the experience-based account to language acquisition (e.g. Goldberg 2003, 2006; Tomasello 2000, 2003). Specifically, they argued that if the first language acquisition was experience-based, it was hard to justify why children showed non-adult patterns. However, as we pointed it out, Jing et al.'s (2005) experimental design might mislead adults to merely pay attention to the disjunctive interpretation. In addition, the current experimental results indicated that adults actually set the conjunctive interpretation as the default. Therefore, it is arguable whether Jing et al.'s (2005) results could still stand as a piece of evidence to argue against the experience-based approach to language acquisition. Similarly, in a study focusing on children's downward entailment interpretation, Su et al. (2012) showed that the adult controls could construe the conjunctive interpretation when *huozhe* 'or' appeared under the scope of a negation, which was contrary to Jing et al.'s (2005) finding. In order to account for the discrepancy, Su et al. (2012: 975) argued that the different negative structures under investigation might be the reason. More specifically, the negation and disjunction appeared as clause mates in Jing et al.'s (2005) study while the negation appeared in higher clauses than the disjunction in Su et al.'s (2012) study. However, based on the results from the current experiment, the argument proposed by Su et al. (2012) became redundant because adults indeed preferred the conjunctive interpretation when the negation and the disjunction were clause mates. In short, one essential implication from the current results is that understanding the adults' linguistic patterns is always a prerequisite to the study of children's language acquisition patterns.

However, at least two objections can be made about the experimental results. The first objection concerns the word frequency effect and repetition effect of the last two syllables at the end of conjunction-biased sentences and disjunction-biased sentences. Take (9) for instance. The word frequency of *xihuan* 'like' in (9a) and the word frequency of *yi-zhong* 'one kind' in (9b) were not identical. Further, the last region of the conjunction-biased sentences was always the same three characters (i.e. *bu-xihuan* 'do(es) not like'), repeated for each of the fourteen sentences;

on the other hand, the last region of the disjunction-biased sentences was always different, and there were fourteen different verb characters for the fourteen sentences. Therefore, the observed reading time differences between these two conditions could result from these factors. The concern, however, could be erased after a closer examination of the results. First of all, the first observed reading time difference was at region 11 and the syllables were always *dou* 'all' in conjunction-biased sentences and *zhi* 'only' in disjunction-biased sentences. If the reading time difference was a function of the repetition effect, the reading time difference at region 11 became unjustifiable. Secondly, it was true that the word frequency of *xihuan* 'like' in (9a) and the word frequency of *yi-zhong* 'one kind' in (9b) were not identical. A corpus search using Chinese Sketch Engine (<http://wordsketch.ling.sinica.edu.tw>) (Huang et al. 2005; Kilgarriiff et al. 2004) revealed that, there were 3,374 instances of *xihuan* 'like' and 6,472 instances of *yi-zhong* 'one kind'. If word frequency had been a factor, it would be expected that the reading time for *yi-zhong* 'one kind' should be facilitated and thus should be shorter. However, although reading disjunction-biased sentences might receive extra benefits from the word frequency effect, the fact that the participants spent significantly more reading time and acceptability-judging time on those sentences lent even stronger support to the conclusion that conjunction-biased sentences were easier to comprehend. Third, the conclusion claiming that conjunctive interpretation was the default interpretation was drawn not solely from the reading time differences but also the results of the acceptability judgment. As shown in Table 2, regardless of the question types, the participants consistently set conjunctive interpretations as the default reading. In short, based on the reading time differences observed at region 11, acceptability-judging section and the results from the acceptability judgment, extraneous variables such as the word frequency effect and repetition effect might play insignificant roles in current experimental results.

The second objection relates to the selection of the sentences. More specifically, there were unambiguous ways to express the conjunctive interpretation and the disjunctive interpretation under negation. (10) lists two examples.

(10) a. *Conjunctive Interpretation*

Ta ji mei-chi qingjiao, ye mei-chi qiezi.
 he yet not-eat green peppers too not-eat eggplants
 'He did not eat green peppers and eggplants.'

b. *Disjunctive Interpretation*

Ta yaome mei-chi qingjiao, yaome mei-chi qiezi.
 he either not-eat green peppers either not-eat eggplants
 'He did not eat green peppers or he did not eat eggplants.'

Therefore, if there were unambiguous ways to express similar meanings, native speakers of Mandarin Chinese might avoid using the ambiguous sentences presented in the current study. That is, the ambiguous sentences used in the current study were less likely to be used when alternative unambiguous expressions existed. However, this objection was undermined when the results shown in Table 2 were considered. As it was shown in Table 2, native speakers of Mandarin Chinese did not acknowledge the existence of the ambiguity. That is, native speakers of Mandarin Chinese might unconsciously treat sentences uttered by interlocutor A presented in (9) as unambiguous ones and therefore it was not unlikely that those kinds of sentences were chosen when the speakers intended to express the conjunctive interpretation.

An anonymous reviewer raised the possibility that the experimental design might contain a bias against Jing's claim. The reviewer pointed out that one unintended consequence of balancing *Yes* and *No* answers in the fillers was that the participants were encouraged to balance out their *Yes* and *No* responses across all trials, an effect observed by Sprouse (2007). That is, if Jing's claim was on the right track, the prediction from our experimental design was that the participants should respond *Yes* to all non-filler sentences, which was a bias against the balancing effect observed by Sprouse (2007). However, as the same reviewer pointed it out, even if such an effect existed, the effect would not explain the particular direction of bias we observed (i.e. the favor of the conjunctive interpretations). Furthermore, if the participants' favoring of the conjunctive interpretations was due to the balancing effects, it was difficult to justify the fact that they spent significantly longer time reading the last region of the sentences in the disjunction-biased context. The current discussion further leads us to the fact that the quantitative method (the reading time in the current case) and the intuitive judgement (the acceptability judgement in the current case) are equally important to the current study. This study demonstrates that these methods could compensate each other and collectively help us understand the essence of certain linguistic phenomena.

At the end of our discussion, we should like to bring up the issue of *huo* and *huozhe* in Mandarin Chinese. In the current study, the participants were from Taiwan and the corpus we used to argue that *huo* is more natural than *huozhe* was also from Taiwan. We, therefore, acknowledge the possibility that the different results between the current study and Jing et al.'s (2005) study may be due to the cross-strait linguistic variation or the uses of *huo* and *huozhe* in the experimental sentences. This issue deserves an independent study in the future.

5. Concluding remarks

Contrary to Jing's (2008) assertion that both disjunction and conjunction readings are equally prominent in simple negative statements containing *huo* 'or' in an out-of-the-blue context, the results from the quantitative data revealed that the conjunction reading is the default meaning. We argue that the quantitative method and the intuitive judgment can compensate each other and collectively provide insights into certain linguistic phenomena. Furthermore, one significant implication from the current results is that understanding the adults' linguistic patterns is always a prerequisite to the study of children's language acquisition patterns.

The understanding of the default meaning is essential and can be further applied to several other domains in linguistics or applied linguistics. For instance, Liu (2014) applies the simple negative statements containing *huo* 'or' to investigate if individuals with Asperger syndrome have semantic or pragmatic deficit. Furthermore, with the understanding of the default interpretation of simple negative statements containing *huo* 'or', the role of prosody in sentence comprehension can be further studied. More specifically, with the understanding of the default interpretation, further investigations can reveal if the default meaning will be affected when the *huo* 'or' is pronounced with or without stress. Those facts indicate that the current study, focusing on the default interpretation of simple negative statements containing *huo* 'or', is practically essential.

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Appendix 1. Critical items in the experiment

The (a) sentences are responses with the conjunction-biased interpretation and (b) sentences are responses with the disjunction-biased interpretation.

- A1 A: Ta mei-guang yeshi huo laojie
 he not-shop night market or old street
 'He did not go to the night market or the old street.'
- (a) B: Dui-a yeshi han laojie ta dou bu-xihuan
 yes-MP night market and old street he all not-like
 'Yes! He liked neither the night market nor the old street.'
- (b) B: Dui-a yeshi han laojie ta zhi guang-yi-zhong
 yes-MP night market and old street he only shop-one-kind
 'Yes! He only shopped one of them.'

- A2 A: Ta mei-chi qingjiao huo qiezi
he not-eat green pepper or eggplant
'He did not eat the green peppers or the eggplants.'
- (a) B: Dui-a qingjiao han qiezi ta dou bu-xihuan
yes-MP green pepper and eggplant he all not-like
'Yes! He liked neither the green peppers nor the eggplants.'
- (b) B: Dui-a qingjiao han qiezi ta zhi chi-yi-zhong
yes-MP green pepper and eggplant he only eat-one-kind
'Yes! He only ate one of them.'
- A3 A: Ta mei-chuan qiuxie huo pixie
he not-wear sneaker or leather shoe
'He did not wear the sneakers or the leather shoes.'
- (a) B: Dui-a qiuxie han pixie ta dou bu-xihuan
yes-MP sneakers and leather shoe he all not-like
'Yes! He liked neither the sneakers nor the leather shoes.'
- (b) B: Dui-a qiuxie han pixie ta zhi chuan-yi-zhong
yes-MP sneaker and leather shoe he only wear-one-kind
'Yes! He only wore one of them.'
- A4 A: Ta mei-mai chezi huo fangzi
he not-buy car or house
'He did not buy the cars or the houses.'
- (a) B: Dui-a chezi han fangzi ta dou bu-xihuan
yes-MP car and house he all not-like
'Yes! He liked neither the cars nor the houses.'
- (b) B: Dui-a chezi han fangzi ta zhi mai-yi-zhong
yes-MP car and house he only buy-one-kind
'Yes! He only bought one of them.'
- A5 A: Ta mei-dai shoubiao huo xianglian
he not-wear watch or necklace
'He did not wear the watches or the necklaces.'
- (a) B: Dui-a shoubiao han xianglian ta dou bu-xihuan
yes-MP watch and necklace he all not-like
'Yes! He liked neither the watches nor the necklaces.'
- (b) B: Dui-a shoubiao han xianglian ta zhi dai-yi-zhong
Yes-MP watch and necklace he only wear-one-kind
'Yes! He only wore one of them.'
- A6 A: Ta mei-du xiaoshuo huo zazhi
he not-read novel or magazine
'He did not read the novels or the magazines.'
- (a) B: Dui-a xiaoshuo han zazhi ta dou bu-xihuan
yes-MP novel and magazine he all not-like
'Yes! He liked neither the novels nor the magazines.'

(b) B: Dui-a xiaoshuo han zazhi ta zhi du-yi-zhong
 yes-MP novel and magazine he only read-one-kind
 'Yes! He only read one of them.'

A7 A: Ta mei-chang laoge huo minge
 he not-sing old-song or folk-song
 'He did not sing the old songs or the folk songs.'

(a) B: Dui-a laoge han minge ta dou bu-xihuan
 yes-MP old-song and folk-song he all not-like
 'Yes! He liked neither the old songs nor the folk songs.'

(b) B: Dui-a laoge han minge ta zhi chang-yi-zhong
 yes-MP old-song and folk-song he only sing-one-kind
 'Yes! He only sang one of them.'

A8 A: Ta mei-he guozhi huo hongcha
 he not-drink juice or black-tea
 'He did not drink the juice or the black tea.'

(a) B: Dui-a guozhi han hongcha ta dou bu-xihuan
 yes-MP juice and black-tea he all not-like
 'Yes! He liked neither the juice nor the black tea.'

(b) B: Dui-a guozhi han hongcha ta zhi he-yi-zhong
 yes-MP juice and black-tea he only drink-one-kind
 'Yes! He only drank one of them.'

A9 A: Ta mei-xue Fawen huo Dewen
 he not-learn French or German
 'He did not learn French or German.'

(a) B: Dui-a Fawen han Dewen ta dou bu-xihuan
 yes-MP French and German he all not-like
 'Yes! He liked neither French nor German.'

(b) B: Dui-a Fawen han Dewen ta zhi xue-yi-zhong
 yes-MP French and German he only learn-one-kind
 'Yes! He only learned one of them.'

A10 A: Ta mei-kan dianying huo katong
 he not-watch movie or cartoon
 'He did not watch the movies or the cartoons.'

(a) B: Dui-a dianying han katong ta dou bu-xihuan
 yes-MP movie and cartoon he all not-like
 'Yes! He liked neither the movies nor the cartoons.'

(b) B: Dui-a dianying han katong ta zhi kan-yi-zhong
 yes-MP movie and cartoon he only watch-one-kind
 'Yes! He only watched one of them.'

A11 A: Ta mei-zhu fandan huo minsu
 he not-live hotel or guest-house
 'He did not live in the hotel or in the guest house.'

- (a) B: Dui-a fandian han minsu ta dou bu-xihuan
yes-MP hotel and guest-house he all not-like
'Yes! He liked neither the hotel nor the guest house.'
- (b) B: Dui-a fandian han minsu ta zhi zhu-yi-zhong
yes-MP hotel and guest-house he only live-one-kind
'Yes! He only lived in one of them.'

A12 A: Ta mei-yang xiaogou huo xiaomao
he not-keep puppy or kitten
'He did not keep the puppies or the kittens.'

- (a) B: Dui-a xiaogou han xiaomao ta dou bu-xihuan
yes-MP puppy and kitten he all not-like
'Yes! He liked neither the puppies nor the kittens.'
- (b) B: Dui-a xiaogou han xiaomao ta zhi yang-yi-zhong
yes-MP puppy and kitten he only keep-one-kind
'Yes! He only kept one of them.'

A13 A: Ta mei-jiao binlang huo ruantang
he not-chew betel-nut or soft-sweet
'He did not chew the betel nuts or the soft sweets.'

- (a) B: Dui-a binlang han ruantang ta dou bu-xihuan
yes-MP betel-nut and soft-sweet he all not-like
'Yes! He liked neither the betel nuts nor the soft sweets.'
- (b) B: Dui-a binlang han ruantang ta zhi jiao-yi-zhong
yes-MP betel-nut and soft-sweet he only chew-one-kind
'Yes! He only chewed one of them.'

A14 A: Ta mei-zhu kugua huo qincai
he not-cook bitter-melon or celery
'He did not cook the bitter melons or the celery.'

- (a) B: Dui-a kugua han qincai ta dou bu-xihuan
yes-MP bitter-melon and celery he all not-like
'Yes! He liked neither the bitter melons nor the celery.'
- (b) B: Dui-a kugua han qincai ta zhi zhu-yi-zhong
yes-MP bitter-melon and celery he only cook-one-kind
'Yes! He only cooked one of them.'

Appendix 2. Fillers in the experiment

The answers are indicated within the parentheses.

- B1 A: Ta bu-wan leiqiu huo zhuangqiu
he not-play softball or billiards
'He does not play softball or billiards.'

- B: Dui-a leiqiu han zhuangqiu ta dou hen-xihuan
yes-MP softball and billiards he all very-like
'Yes! He likes softball and billiards very much.' (No)
- B2 A: Ta mei-wan leiqiu huo zhuangqiu
he not-play softball or billiards
'He did not play softball or billiards.'
- B: Dui-a leiqiu han zhuangqiu ta dou hen-xihuan
yes-MP softball and billiards he all very-like
'Yes! He liked softball and billiards very much.' (No)
- B3 A: Ta bu-wan leiqiu huo zhuangqiu
he not-play softball or billiards
'He does not play softball or billiards.'
- B: Cai guai leiqiu han zhuangqiu ta dou bu-xihuan
that's weird softball and billiards he all not-like
'That's weird! He does not like softball and billiards.' (No)
- B4 A: Ta mei-wan leiqiu huo zhuangqiu
he not-play softball or billiards
'He did not play softball or billiards.'
- B: Cai guai leiqiu han zhuangqiu ta dou bu-xihuan
that's weird softball and billiards he all not-like
'That's weird! He did not like softball and billiards.' (No)
- B5 A: Ta bu-chi qingjiao huo qiezi
he not-eat green pepper or eggplant
'He does not eat the green peppers or the eggplants.'
- B: Dui-a qingjiao han qiezi ta dou hen-xihuan
yes-MP green peper and eggplant he all very-like
'Yes! He likes both green peppers and eggplants very much.' (No)
- B6 A: Ta mei-chi qingjiao huo qiezi
he not-eat green pepper or eggplant
'He did not eat the green peppers or the eggplants.'
- B: Dui-a qingjiao han qiezi ta dou hen-xihuan
yes-MP green peper and eggplant he all very-like
'Yes! He liked both the green peppers and the eggplants very much.' (No)
- B7 A: Ta bu-chi qingjiao huo qiezi
he not-eat green pepper or eggplant
'He does not eat the green peppers or the eggplants.'
- B: Bu-zhi kugua han luobo ta ye dou-bu-ai
What's-more bitter-melon and radish he also all-not-love
'What's more! He does not love the bitter melons and the radishes either.' (Yes)
- B8 A: Ta mei-chi qingjiao huo qiezi
he not-eat green pepper or eggplant
'He did not eat the green peppers or the eggplants.'

- B: Bu-zhi kugua han luobo ta ye dou-bu-ai
What's-more bitter-melon and radish he also all-not-love
'What's more! He did not love the bitter melons and the radish either.' (Yes)
- B9 A: Ta bu-mai chezi huo fangzi
he not-buy car or house
'He does not buy the cars or the houses.'
- B: Dui-a chezi han fangzi ta dou hen-xihuan
yes-MP car and house he all very-like
'Yes! He likes both the cars and the houses very much.' (No)
- B10 A: Ta mei-mai chezi huo fangzi
he not-buy car or house
'He did not buy the cars or the houses.'
- B: Dui-a chezi han fangzi ta dou hen-xihuan
yes-MP car and house he all very-like
'Yes! He liked both the cars and the houses very much.' (No)
- B11 A: Ta bu-mai chezi huo fangzi
he not-buy car or house
'He does not buy the cars or the houses.'
- B: Cai guai chezi han fangzi ta dou bu-xihuan
that's weird car and house he all not-like
'That's weird! He does not like the cars and the houses.' (No)
- B12A: Ta mei-mai chezi huo fangzi
he not-buy car or house
'He did not buy the cars or the houses.'
- B: Cai guai chezi han fangzi ta dou bu-xihuan
that's weird car and house he all not-like
'That's weird! He did not like the cars and the houses.' (No)
- B13 A: Ta bu-du xiaoshuo huo zazhi
he not-read novel or magazine
'He does not read the novels or the magazines.'
- B: Dui-a xiaoshuo han zazhi ta dou hen-xihuan
yes-MP novel and magazine he all very-like
'Yes! He likes both the novels and the magazines very much.' (No)
- B14A: Ta mei-du xiaoshuo huo zazhi
he not-read novel or magazine
'He did not read the novels or the magazines.'
- B: Dui-a xiaoshuo han zazhi ta dou hen-xihuan
yes-MP novel and magazine he all very-like
'Yes! He liked both the novels and the magazines very much.' (No)
- B15 A: Ta bu-du xiaoshuo huo zazhi
he not-read novel or magazine
'He does not read the novels or the magazines.'

- B: Bu-zhi manhua han baozhi ta ye dou-bu-ai
what's-more comic-books and newspaper he also all-not-love
'What's more! He does not love the comic books and the newspaper either.' (Yes)
- B16 A: Ta mei-du xiaoshuo huo zazhi
he not-read novel or magazine
'He did not read the novels or the magazines.'
- B: Bu-zhi manhua han baozhi ta ye dou-bu-ai
what's-more comic-books and newspaper he also all-not-love
'What's more! He did not love the comic books and the newspaper either.' (Yes)
- B17A: Ta bu-he guozhi huo hongcha
he not-drink juice or black-tea
'He does not drink juice or black tea.'
- B: Dui-a guozhi han hongcha ta dou hen-xihuan
yes-MP juice and black-tea he all very-like
'Yes! He likes both juice and black tea very much.' (No)
- B18 A: Ta mei-he guozhi huo hongcha
he not-drink juice or black-tea
'He did not drink juice or black tea.'
- B: Dui-a guozhi han hongcha ta dou hen-xihuan
yes-MP juice and black-tea he all very-like
'Yes! He liked both juice and black tea very much.' (No)
- B19 A: Ta bu-he guozhi huo hongcha
he not-drink juice or black-tea
'He does not drink juice or black tea.'
- B: Bu-zhi qishui han lucha ta ye dou-bu-ai
what's-more soda and green-tea he also all-not-love
'What's more! He does not love soda and green tea either.' (Yes)
- B20 A: Ta mei-he guozhi huo hongcha
he not-drink juice or black-tea
'He did not drink juice or black tea.'
- B: Bu-zhi qishui han lucha ta ye dou-bu-ai
what's-more soda and green-tea he also all-not-love
'What's more! He did not love soda and green tea either.' (Yes)
- B21 A: Ta bu-tan pipa huo jita
he not-play pipa or guitar
'He does not play the pipa or the guitar.'
- B: Bu-zhi guzheng han gangqin ta ye dou-bu-ai
what's-more zither and piano he also all-not-love
'What's more! He does not love the zither and the piano either.' (Yes)
- B22A: Ta mei-tan pipa huo jita
he not-play pipa or guitar
'He did not play the pipa or the guitar.'

- B: Bu-zhi guzheng han gangqin ta ye dou-bu-ai
 what's-more zither and piano he also all-not-love
 'What's more! He did not love the zither and the piano either.' (Yes)
- B23 A: Ta bu-zhu kugua huo qincai
 he not-cook bitter melon or celery
 'He does not cook the bitter melons or the celery.'
- B: Bu-zhi xiangcai han sigua ta ye dou-bu-ai
 what's-more cilantro and loofah he also all-not-love
 'What's more! He does not love the cilantro and the loofah either.' (Yes)
- B24 A: Ta mei-zhu kugua huo qincai
 he not-cook bitter melon or celery
 'He did not cook the bitter melons or the celery.'
- B: Bu-zhi xiangcai han sigua ta ye dou-bu-ai
 what's-more cilantro and loofah he also all-not-love
 'What's more! He did not love the cilantro and the loofah either.' (Yes)
- B25 A: Ta bu-kan xiju huo dianying
 he not-watch comedy or movie
 'He does not watch the comedies or the movies.'
- B: Bu-zhi geju han yingji ta ye dou-bu-ai
 what's-more opera and TV-series he also all-not-love
 'What's more! He does not love the operas and the TV series either.' (Yes)
- B26 A: Ta mei-kan xiju huo dianying
 he not-watch comedy or movie
 'He did not watch the comedies or the movies.'
- B: Bu-zhi geju han yingji ta ye dou-bu-ai
 what's-more opera and TV-series he also all-not-love
 'What's more! He did not love the operas and the TV series either.' (Yes)
- B27 A: Ta bu-xue chahua huo shuicai
 he not-learn illustration or watercolor-painting
 'He does not learn illustration or watercolor painting.'
- B: Bu-zhi sumiao han youhua ta ye dou-bu-ai
 what's-more sketching and oil-painting he also all-not-love
 'What's more! He does not love sketching and oil painting either.' (Yes)
- B28 A: Ta mei-xue chahua huo shuicai
 he not-learn illustration or watercolor-painting
 'He did not learn illustration or watercolor painting.'
- B: Bu-zhi sumiao han youhua ta ye dou-bu-ai
 what's-more sketching and oil-painting he also all-not-love
 'What's more! He did not love sketching and oil painting either.' (Yes)

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